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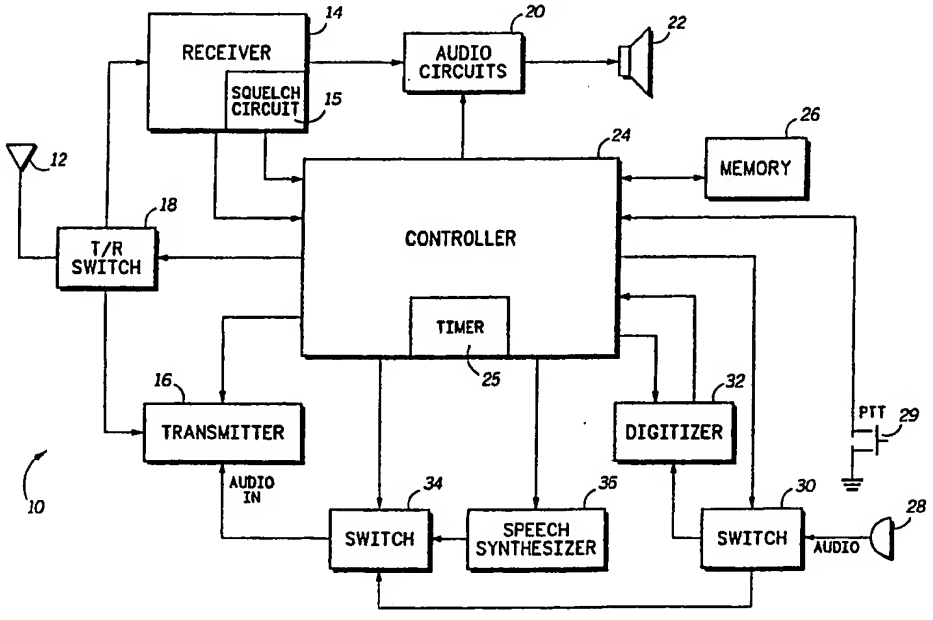
(54) Title: TWO-WAY RADIO WITH VOICE STORAGE



(57) Abstract

A two-way radio (10) includes a receiver (14) having a squelch circuit (15) for determining if a communication channel is available. A transmitter (16) is provided for transmitting voice messages on the channel. When the communication channel is available, voice signals are directed from a microphone (28) to the transmitter (16) for transmission. When the communication channel is not available, the voice signals are automatically directed to a digitizer (32) where they are digitized. The digitized voice signals are stored in a memory (26) for later transmission when the channel becomes available.

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Two-Way Radio With Voice Storage

Background of the Invention

This invention relates to two-way radios in general, and in particular to radios having a voice storage means, which can be utilized to store and later transmit a voice message. Known voice storage radios are utilized for voice mailbox purposes. That is, voice messages are either received and stored by the radio for later review, or the message is stored and later transmitted on command or request. These approaches provide for either incoming or outgoing voice mail.

When radios are operated on shared frequencies, it is important that only a single radio transmit on any give frequency , within a geographical area at a time. Where a radio is operating in a carrier squelch mode, the user can readily ascertain if the channel is in use by whether the radio is unsquelched, in which case the radio

is producing an audio output. For coded squelch operation, such as subaudible tone or digital code, a monitor switch is often provided to permit the radio user to defeat the coded squelch operation to monitor the channel for activity. Some systems provide automatic transmit inhibit, preventing transmission by the radio if a signal is present on the channel.

Where a radio user desires to transmit a message on a busy channel, he must wait until the channel is clear prior to articulating the message. This is often a disruption to the user who wishes to proceed with other activities, but instead must remain ready to actuate the radio and talk when the channel becomes available. It is desirable to provide a means permitting the user to articulate his message inspite of a busy condition on the channel.

Summary of the Invention

This radio with voice storage permits the user to articulate a voice message regardless of whether the channel is busy. The two-way radio includes a receiver with means for determining if a communication channel is available. A transmitter is provided for transmitting voice messages on the communication channel. The radio includes voice input means and voice storage means. A control means is responsive to the voice input means and the receiver means to direct voice messages from the voice input means to the transmitter for transmission when the communication is available. When the communication channel is not available, voice messages are directed to the voice storage means for later transmission when the channel is available.

In one aspect of the invention, the control means is further responsive to the receiver means to direct voice messages from the voice storage means to the transmitter for transmission when the communication channel becomes available. In another aspect of the invention, the receiver means includes a squelch circuit. In still

another aspect of the invention, the voice input means includes a microphone and an activation switch. In yet another aspect of the invention, the voice storage means includes a digitizer for digitizing voice signals and a memory for storing the digitized voice signals. In another aspect of the invention, the voice storage means includes a digital-to-analog converter for converting digitized voice signals to analog signals prior to transmission.

Brief Description of the Drawings

FIG. 1 is a block diagram of a two-way radio in accordance with the present invention.

FIG. 2 is a flowchart illustrating the operation of the radio of FIG. 1.

Description of the Preferred Embodiment

Referring now by characters of reference to the drawings, and first to FIG. 1, it will be understood that a two-way radio 10 includes an antenna 12 which is selectively connected to a receiver 14 or to a transmitter 16 by a T/R switch 18 in a conventional manner. Received audio signals from receiver 14 are applied to audio circuits 20 for amplification prior to being applied to a speaker 22. The receiver 14 includes a squelch circuit 15 which provides a squelch output that is applied to an input of a controller 24. An output of controller 24 provides a mute control signal to audio circuits 20. The controller 24, which preferably comprises a microprocessor, is connected to a memory 26 in a conventional manner. The controller also includes output lines for controlling the T/R switch 18, receiver 14 and transmitter 16.

A microphone 28, comprising voice input means, includes a push-to-talk (PTT) switch, comprising an activation switch, which

provides a control signal to an input of controller 24. Audio signals from microphone 28 are supplied to a switch 30, which is controlled by an output line of controller 24. One output of switch 30 is connected to the input of a digitizer 32 which is used to digitize voice signals and supply the digitized signals to controller 24 for storage in memory 26. The digitizer 32 operates under the control of controller 24 which may process the digitized signals prior to storage using known data compression or protection techniques. Another output of switch 30 is connected to an input of a second switch 34 which is also controlled by controller 24. A speech synthesizer 36 is connected to the controller for receiving digitized voice signals from controller 24. The output of speech synthesizer 36 is connected to a second input of switch 34. The output of switch 34 supplies the audio input signal to the transmitter 16.

The operation of radio 10 may be best understood by reference to flow chart of FIG. 2. The controller 24 monitors the PTT signal from microphone 28. As illustrated at decision block 50, if the PTT switch is not actuated, the controller continues to monitor the PTT signal. If the PTT switch is actuated, the controller 24 mutes the audio circuits 20 (block 52) and determines if the channel is busy based upon the squelch signal of receiver 14 (block 54). If the channel is not busy the voice message is transmitted (block 56). Controller 24 actuates switches 30 and 34 to route audio signals from microphone 28 to transmitter 16, which is actuated on and T/R switch 18 connects antenna 12 to the transmitter output for radiating the modulated RF signals. When the PTT switch is released, transmission ceases and the receiver can be unmuted if their is a signal present on the channel. In the event that the channel is busy when the PTT is actuated, the radio begins voice digitization and storage (block 58). Switch 30 is actuated to route audio signals from microphone 28 to digitizer 32. The digitized signals are stored in

memory 26. The controller 24 continues to monitor the receiver squelch output during this process (block 60). The storage continues as long as the channel remains busy and the PTT remains actuated (subject to available memory capacity).

If the channel becomes available during the digitization process, the stored speech is synthesized and transmitted while continuing to digitized the voice signal (block 62). The controller 24 reads the stored digitized voice from the memory 26 and applies it to speech synthesizer 36. Switch 34 is actuated to supply the synthesized speech to the transmitter 16, which is actuated on and its output is applied via T/R switch 18 to antenna 12. As long as the PTT 29 remains actuated (block 64), additional voice signals continue to be digitized and stored. When the PTT is released, digitization and storage ceases (block 66) but the transmission continues until the complete message has been synthesized and transmitted (block 68). Where the complete message has been digitized prior to the channel becoming available, as indicated by the PTT not being actuated at block 70, digitization ceases when the PTT 29 is released (block 72). The controller 25 monitors the squelch signal until the channel becomes available (block 74). The stored message is then synthesized and transmitted (block 76).

By digitizing and storing voice messages, channel interference is avoided and the user of the radio 10 is able to enter a voice message without delay and without any user intervention other than the normal actuation of a PTT switch or its equivalent. While the controller 24 uses the receiver squelch signal to determine channel availability, the controller can include a timer 35 for adding a random time delay at blocks 54, 60, and 74 prior to deciding that the channel is not busy. This will delay initiation of transmissions to resolve contention issues on the channel.

I claim as my invention:

Claims

1. A two-way radio comprising:

a receiver including means for determining if a communication channel is available,

a transmitter for transmitting voice messages on the communication channel,

voice input means,

voice storage means, and

control means responsive to the voice input means and said receiver, the control means directing voice messages from the voice input means to the transmitter for transmission when the communication channel is available and to the voice storage means for storage when the communication channel is not available.

2. A two-way radio as defined in claim 1, in which:
the control means is further responsive to said receiver means to automatically direct voice messages from the voice storage means to the transmitter for transmission when said communication channel becomes available.

3. A two-way radio as defined in claim 2, in which:
said receiver means includes a squelch circuit.

4. A two-way radio as defined in claim 1, in which :
the voice input means includes a microphone and an activation switch.

5. A two-way radio as defined in claim 1, in which:
the voice storage means includes a digitizer for digitizing voice signals, and a memory for storing digitized voice signals.

6. A two-way radio as defined in claim 5, in which:
the voice storage means further includes a digital-to-analog converter for converting stored digitized voice signals to analog signals prior to transmission.

7. A two-way radio comprising:

a receiver including a squelch circuit for determining if a communication channel is available,

a transmitter for transmitting voice messages on the communication channel,

voice input means including a microphone and an activation switch,

voice storage means including a digitizer and a memory, and

control means responsive to the activation switch and to said squelch circuit , the control means automatically directing voice signals from the microphone to the transmitter for transmission when the communication channel is available and to the voice storage means for storage in the memory when the communication channel is not available.

8. A method of transmitting a voice message via a radio transmitter comprising the steps of:

determining whether a communication channel is available,

when the communication channel is available, transmitting the voice message without storing the message, and

when the communication channel is not available, storing the voice message until the communication channel becomes available, and then transmitting the stored voice message.

9. A method of transmitting a voice message as defined in claim 8 in which the step of storing the voice message includes the steps of:

first digitizing the voice message, and

then storing the digitized voice message in a memory.

10. A method of transmitting a voice message as defined in claim 9, in which the step of determining whether the communication channel is available includes detecting the presence or absence of a signal on the channel by using a squelch circuit.

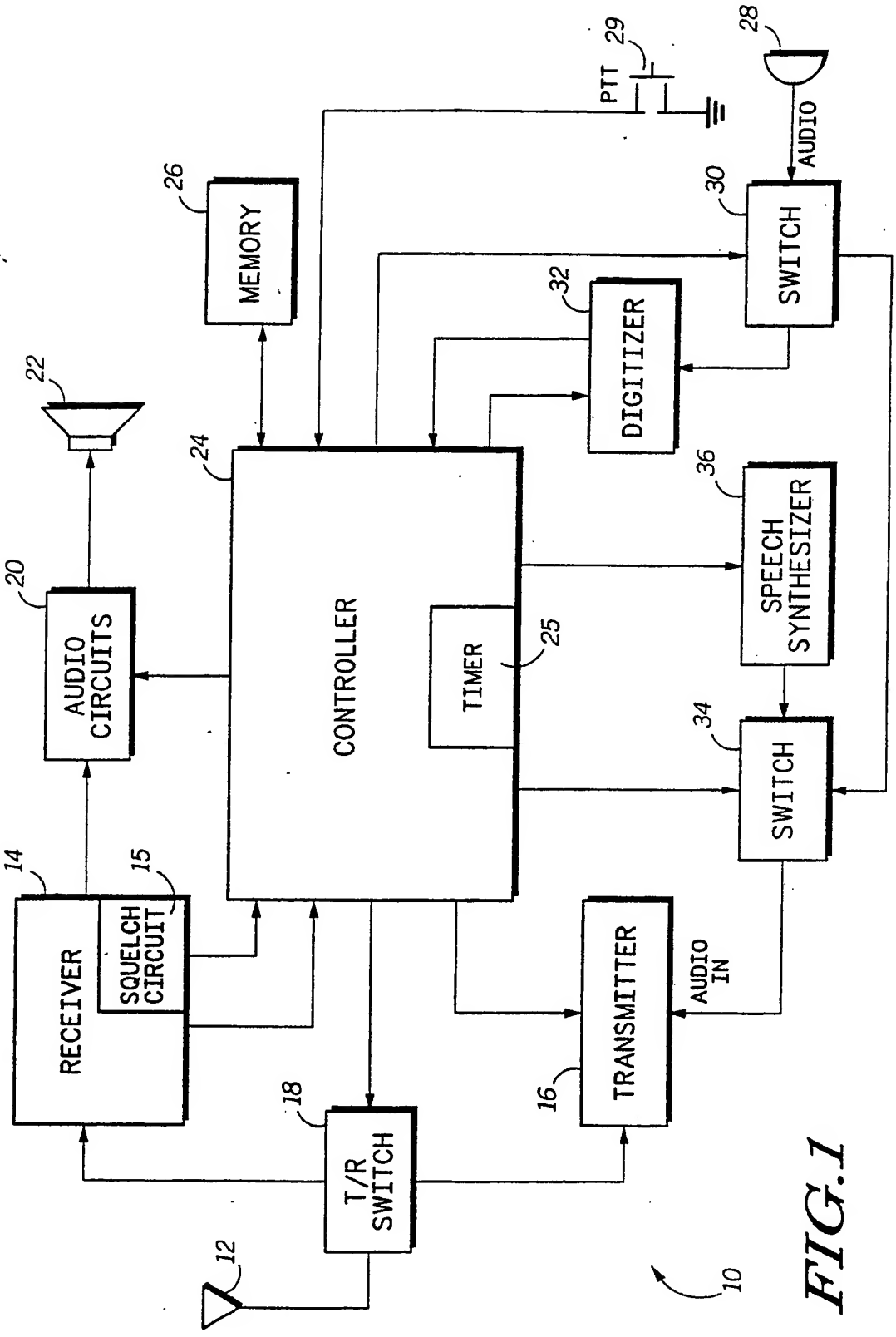
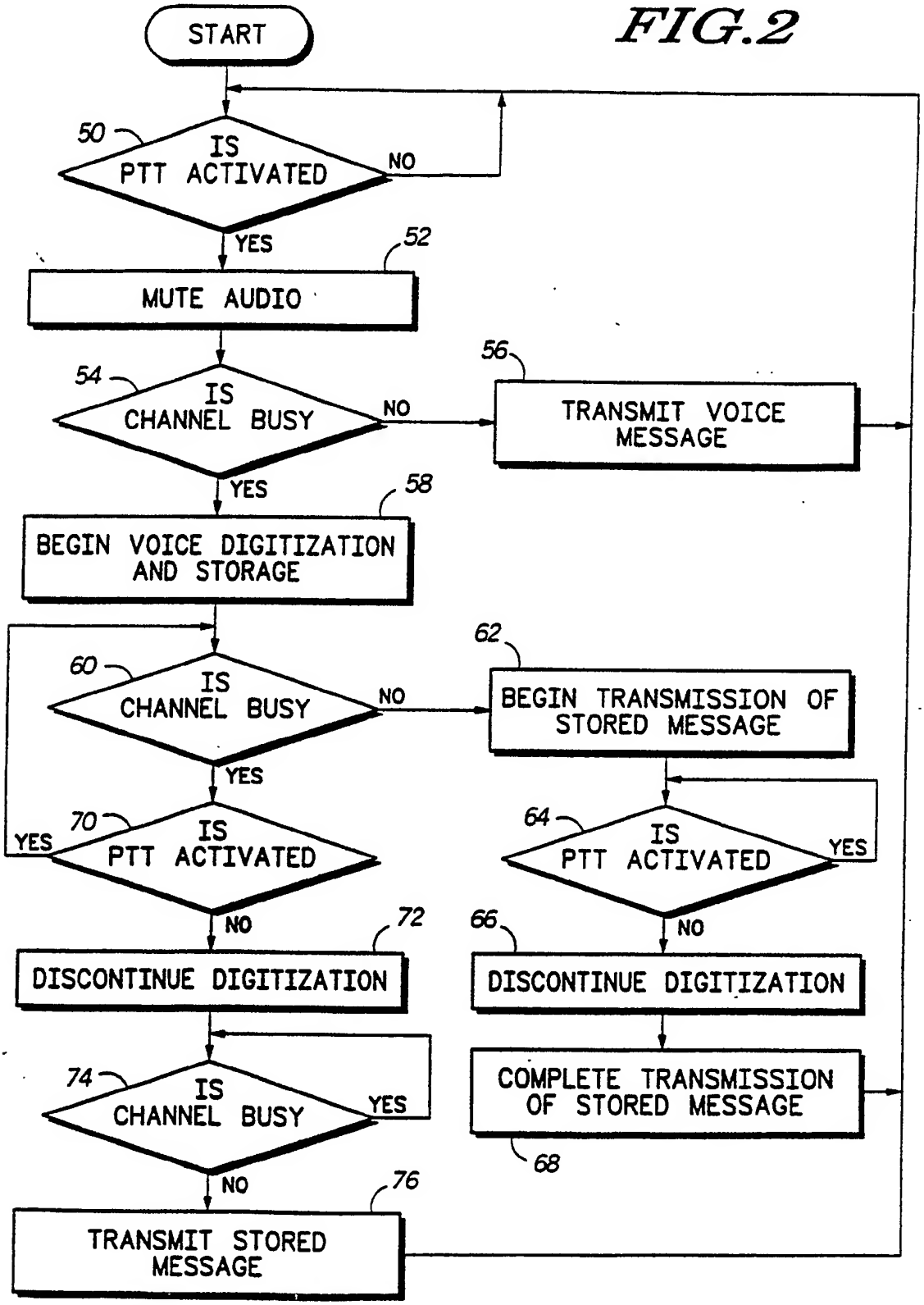


FIG. 1

FIG.2



INTERNATIONAL SEARCH REPORT

International Application No. PCT/US89/05176

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(5): H04B 1/38, 1/44, 1/46, 1/20 H04H 9/00
U.S. CL: 455/78, 79, 82, 89 369/6, 7

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
U.S.	455/78, 79, 82, 89, 369/6, 7

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document; [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	US, A, 4,742,514 (GOODE ET AL.) 3 May 1988 (See Figure #4 and the entire document)	1-5, 7-10
Y	US, A, 4,495,647 (BURKE ETAL) 22 January 1985 (See column 1, lines 60-64)	6

* Special categories of cited documents: [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
03 January 1989	06 FEB 1990
International Searching Authority	Signature of Authorized Officer
ISA/U.S.	Lisa B. Charouel